portions of this section.

IV. ALTERNATIVES EVALUATION

The overall objective of the remedial actions at the Site is to effectively mitigate and minimize threats to and provide adequate protection of public health, welfare and the environment. Specifically, the FS evaluated alternatives which addressed the following three remedial objectives:

1. Protection of the public health and surface waters from direct contact exposure to soils/sludges contaminated with elevated levels of arsenic, lead and chromium.

2. Protection of the public health, welfare and environment from the contaminated soils, odors and leachate in or emanating from the East Hide Pile.

3. Protection of the public health and environment from groundwater contaminated with benzene and toluene.

A. Alternatives Development, Screening and Analysis

Pursuant to § 300.68 (f) 74 alternatives were developed for possible application at this Site. Each alternative was screened with the criteria set forth in § 300.68 (g). Waste characteristics and general Site conditions permit the application of discrete remedial alternatives to each environmental problem, much like a series of operable units. For example, a discrete set of remedial alternatives to address the direct contact problems associated with the contaminated soils was developed and screened. Similarily, sets for air and groundwater actions were also developed. Remedial alternatives to abate any potential impacts to surface waters were incorporated as part of other media's actions. With the exception of the pond and wetlands between the East and West Hide Piles, surface water actions were addressed as part of the soils evaluation. For the pond, its remedial action was incorporated into the evaluation of the East Hide Pile alternatives, referred to as the air alternatives. As a result, the development of alternatives and initial screening are listed by type of media being addressed.

The FS developed and screened a number of classes of alternatives that are based on similar technologies. Because of these similarities, these technologies provide the same relative benefits and problems, and therefore the FS screened these alternatives as classes instead of discrete alternatives. For example, all stabilization/solidification technologies were screened as a group.

Section 300.68 (g) specifies three broad criteria, cost, acceptable engineering practices and effectiveness, to be applied to the list of alternatives. In applying the cost criteria, the RI evaluated the present worth cost of each alternative. In the majority of cases, differences in costs were not the reason for rejection of an alternative.

The remaining two criteria, acceptable engineering practices and effectiveness are less quantifiable and more dependent on experience and judgment. The nature of the hazardous waste problems and general site conditions permit a wide range of potential alternatives to be considered. When viewed in light of the remedial objectives, however, a number of these alternatives were excluded during the initial screening.

The remedial alternatives not eliminated during the intial screening were retained for a detailed evaluation consistent with 40 CFR Part 300.68(h) which requires that the following factors, as appropriate, be considered:

(i) Refinement and specification of alternatives in detail, with emphasis on use of established technology.

Innovative or advanced technology shall, as appropriate, be evaluated as an alternative to conventional technology.

(ii) Detailed cost estimation, including operation and maintenance costs, and distribution of costs over time;

(iii) Evaluation in terms of engineering implementaiton, reliability, and constructability;

(iv) An assessment of the extent to which the alternative is expected to effectively prevent, mitigate, or minimize threats to, and provide adequate protection of public health and welfare and the environment. This shall include an evaluation of the extent to which the alternative attains or exceeds applicable or relevant and appropriate Federal public health and environmental requirements. [Where the analysis determines that Federal public health and environmental requirements are not applicable or relevant and appropriate, the analysis shall, as appropriate, evaluate the risks of the various exposure levels projected or remaining after implementation of the alternative under consideration];

(v) An analysis of whether recycle/reuse, waste minimization, waste biodegradation, or destruction or other advanced, innovative, or alternative technologies is appropriate to reliably minimize present or future threats to public health or welfare or the environment;

(vi) An analysis of any adverse environmental impacts, methods for mitigating these impacts, and costs of mitigation.

For ease of reading, each environmental problem identified in the FS will be discussed separately. Beginning with soils, discussion of initial screening of alternatives will be followed by the detailed analysis for that particular problem.

For each alternative evaluated under this section a brief summary of whether the alternative meets or exceeds applicable or relevant and appropriate Federal public health and environmental requirements will be included in the narrative. For a more detailed analysis of the applicable or relevant and appropriate requirements the reader is referred to the section labeled Consistency with Other Environmental Requirements.

B. Development and Screening of Soils Alternatives

The RI determined that there exists a potential for the public to come in direct contact with soils contaminated with arsenic, lead or chromium. The RI also identified areas where these soils were in contact with surface water or wetlands. Under adverse conditions, these deposits could impact the environment. The FS evaluated a number of alternatives to abate the direct contact problems associated with the metal deposits. Listed below are the remedial alternatives developed for the initial screening for the soils problem.

SOILS ALTERNATIVES

- No Action

Infiltration Control

- Regrade and revegetate contaminated areas to promote site drainage.
- Regrade and cap contaminated areas with clay material.
- Regrade and cap contaminated areas with a synthetic liner.
- Regrade and cap contaminated areas with an asphalt cover.

Removal/Consolidation

- Excavate contaminated areas to depth of water table with off-site disposal.
- Excavate contaminated areas to depth 6 inches below visual detection, with off-site disposal.
- Excavate contaminated areas to depth 6 inches below visual detection, consolidate between East and East Central Hide Piles, and cap.
- Excavate contaminated areas to depth 6 inches below visual detection, consolidate around East-Central Hide Pile, and cap.

- Excavate contaminated areas to depth 6 inches below visual detection, consolidate between East and East-Central Hide Piles, and cap.

- Excavate contaminated areas, construct RCRA-permitted hazardous waste facility, consolidate waste, cap according to RCRA regulation.

- Excavate and land farm contaminated areas.

- Excavate contaminated areas, encapsulate, and rebury on-site.

Soil/Sediment Treatment

- Incinerate excavated contaminated areas and dispose residue on or off-site.

- Wet air oxidation of excavated contaminated areas and dispose residue on or off-site.

- Cement-based solidification of contaminated areas.

- Lime-based solidification of contaminated areas.

- Thermoplastic-based solidification of contaminated areas.

- Organic polymer-based solidification of contaminated areas.

- Classification-based solidification of contaminated areas.

- Apply solution mining technology to contaminated areas.

- Apply neutralization/detoxification technology to contaminated areas.

- Seed contaminated areas with micro-organisms to achieve degradation and stabilization.

Access/Development Limitation

- Surround site with chain link/barbed wire fence.

- Surround contaminated areas with chain link/barbed wire fence.

- Establish deed restrictions for contaminated area.

- Provide 6 inches of topsoil where necessary and vegetate.

Each alternative was screened to determine its effectiveness in eliminating the potential for direct contact. Additional measures of effectiveness included rendering the wastes inert and minimizing their potential for leaching contaminants into the environment.

A number of remedial alternatives involving various stabilization/solidification techniques were subject to the initial screening. These techniques involve the mixing of a solidifying agent with the waste material to either physically surround or chemically fix the waste into a hard stable mass.

The stabilization/solidification techniques evolved from the Department of Transportation's regulation of the transportation of radioactive waste. As such, many of the techniques used were designed for temporary stabilization of waste and not necessarily long term stability. In addition, these techniques are very waste-specific and require a substantial amount of analytical investigation to determine their effectiveness and compatibility with the waste. Costs associated with these techniques are presently quite high and as a result, it was estimated that implementation of this technique would cost approximately an order of magnitude greater than other techniques capable of obtaining the stated objectives. These remedial alternatives were therefore eliminated from futher evaluation based on cost, acceptable engineering practices and effectiveness.

Encapsulation/Reburial of the contaminated soils was evaluated as a technique which might provide a long term solution for the Site. Encapsulation involves the use of a synthetic compound to physically enclose the waste. At some sites this method has been found to be protective of the public health and environment. It has effectively eliminated the potential for direct contact, reduced infiltration and minimized the potential for leaching. Presently however, this technique has just emerged from bench-scale testing, and no commercially sized unit has been built. Therefore, there is no data to support its long term reliability or engineering feasibility as a remedial alternative. The costs associated with this method are also very high. This technique was eliminated from further analysis.

High temperature incineration with on-site ash disposal was screened. While it is an attractive alternative because it permanently destroys the hazardous waste with no hazardous byproducts, it is not applicable to heavy metals because they cannot be destroyed by oxidation. Thus it was excluded from further consideration.

The use of wet air oxidation/residue reburial was also excluded for reason noted above with respect to high temperature incineration.

Landfarming and in-situ microbial degradation are techniques that use the assimilative capacity of plants or microbes to break down the waste. Under certain conditions these techniques are capable of being effective for a wide range of organic compounds. Metals cannot be broken down however, and as a result this technique was discarded from further consideration.

In-situ solution mining was evaluated as an alternative for metals removal. The technique involves injecting a solvent, usually water or some other aqueous solution, into the area of contamination. The contaminant is stripped from the soils and the contaminated elutriate is recovered, and pumped to the surface for treatment or disposal. This technique is most effective when the contaminated area is relatively homogenous and the contaminant is relatively mobile in the soil. Neither case exists at the Site. In addition, the technique has only seen limited application, usually to areas where a spill has occurred. The size of contaminated area at this Site coupled with the associated problems of collection and disposal make this alternative infeasible for use at the Site. Therefore, this alternative was rejected on the basis of acceptable engineering practices.

The remaining class of techniques considered and rejected was in-situ neutralization/detoxification. Presently this technique is limited to specific chemical contaminants. Given the heterogeneous nature and size of the Site, this alternative is impractical. It was eliminated from further consideration.

C. Detailed Analysis of Soils Alternatives

The retained alternatives were analyzed in greater detail pursuant to 40 C.F.R. Part 300.68 (h). Each alternative was evaluated using the six criteria previously noted.

The FS evaluated thirteen alternatives for the control of the direct contact threat posed by the arsenic, chrome and lead, soils and sludges. These alternatives ranged from the no action alternative to complete off-site removal and disposal.

For ease of reading, the alternatives as discussed in this document will be renumbered from those found in the RI/FS. The changes are summarized below:

New Number	Old number found in RI/FS
S-1 Shall be considered the No Action Alternative	Not specifically addressed in FS as a discrete remedial alternative
S-2	Alternative I page 64
S-3	Alternative II page 65
S-4	Alternative III page 66
S-5	Alternative IV page 67
S-6	Alternative V page 68

S-7	Alternative VI page 69
S-8	Alternative VII page 70
S-9	Alternative VIII page 71
S-10	Alternative IX page 72
S-11	Alternative X page 72
S-12	Alternative XI page 73
S-13	Option II listed in Appendix I. It is the complete off-site disposal option

Based on the EA, the objective of the remedial alternatives addressing contaminated soils and sludges is to prevent the public from coming into direct contact with these materials. The FS analyzed various combinations of caps, both permeable and impermeable, methods of waste removal and consolidation. The FS, completed prior to the current NCP, made several assumptions to form the basis for its evaluation of alternatives. First, the FS assumed that physical barriers between the wastes and the public would meet the remedial objectives for the Site. Second, once the remedial action was implemented, the primary concern would be ensuring that the wastes would not become exposed again. In this regard, the effects of the freeze-thaw cycle and of erosion are the two primary factors most likely to impact the long term effectiveness of the remedial action. Based on these assumptions, the FS further assumes that buildings, lawns and parking lots covering contaminated land would be at least as effective as barriers specifically designed to eliminate the potential for direct contact and would resist the effects of erosion and the freeze-thaw cycle.

Based on these reasonable assumptions the evaluation of the alternatives within the FS does not specifically address developed properties. The FS assumed that developed properties would not require remedial actions. If, however, excavation or removal alternatives were selected, the volume and costs for excavating in developed areas would be significant. For the in-site capping alternatives, institutional controls and existing structures would act as effective barriers to eliminate the potential for direct contact. The cost of additional fill required to cover grassed areas within the developed portion of the Site would need to be developed and added to the total remedial action costs.

S-1 No Action

The no action alternative for contaminated soils was not specifically delineated in the FS as a discrete alternative. Site conditions and RI sampling results indicated that exposed deposits containing high levels of metals pose a direct contact threat. As a result it was assumed that a no action alternative was not a feasible option. For the purpose of this document the no action alternative will be discussed.

A no action alternative assumes that no remedial actions are taken to abate or address problems at the Site, with the exception of quarterly sampling of ground and surface waters and air quality to monitor Site conditions for evidence of a substantial change. Since institutional controls restricting disturbance of the Site are considered a form of remedial action, the no action alternative would permit unrestricted development of the Site. Not only would the hide piles and metals deposits remain exposed at the surface and in contact with Site surface waters, but also during site development these materials would be moved, thereby creating new releases impacting the public health, welfare and environment.

Costs associated with this alternative only involve monitoring costs at $90,000 per year or a present work cost of $850,000 for thirty years.

The implementation of S-1 requires no special engineering techniques as it only requires periodic monitoring. The only permanent structures would be the groundwater monitoring wells, which are reliable and easily constructed. Due to their nature and characteristics the wastes if left undisturbed, will remain relatively stable. If however, Site development is permitted to resume, the reliability of this alternative changes dramatically, releasing odors and toxic dusts to the surrounding community, increasing the direct contact potential and discharging contaminants into the Site surface waters.

The no action alternative does not prevent or abate the threats to or provide adequate protection of public health and welfare and the environment. Under this alternative exposed deposits permit direct contact. They are also toxic to vegetation and will thus remain subject to erosion by surface water run-off. The northern half of the Site is presently undeveloped thereby providing a prime area for easy access. In addition the Site tends to be a local meeting and socializing spot for the area's teenage population. These unauthorized Site activities continue despite repeated attempts at maintaining a chain link fence and posting the Site with warning signs.

As a result, this alternative was found not to be protective of the public health, welfare or environment. In addition, this alternative does not meet or exceed applicable or relevant and appropriate Federal requirements as it would permit the continued release of toxic metal contaminants to impact surface water in violation of Water Quality Criteria. The applicability, relevance and appropriateness of these regulations will be discussed in a subsequent section of this document.
The alternative does not address any form of waste minimization, reuse or containment of the waste.

S-2 Cover contaminated soil deposits having greater than 100ppm of any toxic metal with a 24 inch clay barrier, followed by 6 inches of top soil and establish a vegetative cover.

Alternative S-2 is a source control remedial action that involves leaving the waste deposits in their current location and eliminates any potential for direct contact with the wastes through the use of containment techniques. This alternative involves modifying the Site's contours to establish uniform slopes and covering any contaminated deposits containing above 100 ppm of arsenic, chromium or lead with 24 inch of impermeable material (bentonite/soil mixture with 10^{-7} cm/sec permeability) followed by a 6 inch top soil cover with vegetation. As part of this alternative, the shallow pond located between the East and West Hide Piles would be drained and filled. The use of institutional controls to ensure the effectiveness of the remedial action is included as part of the alternative.

The cover proposed in this alternative would eliminate the direct contact threat by placing the metals deposits below the zone where the freeze-thaw cycle force them back to the surface. Weather conditions in New England produce an action called the freeze-thaw cycle. This cycle produces an effect that tends to force objects and materials found within the frost zone to the surface. An example of this phenomenon is found every spring when farmers "harvest" another crop of rocks that have been pushed to the surface as a result of the previous winter's frosts. Results of field experiences gained in the region indicate that covering with approximately thirty inches of cover material is effective in minimizing the effects of the freeze-thaw cycle. This alternative has the added benefit of providing a level of impermeability which would effectively exclude infiltration from migrating through the wastes. As noted in the previous section, the RI results indicate that while a portion of the metals deposits are in direct contact with groundwater, remedial action relative to leaching of toxic metals was not necessary. Therefore the use of an impermeable cover is unnecessary for preventing continued leaching of wastes to the groundwater, however it is effective in eliminating the potential for direct contact.

As noted above, part of the S-2 proposal is to drain and fill a shallow pond along the northern border of the Site. This action would eliminate approximately 4.1 acres of pond and associated wetlands. The elimination of the pond would serve two purposes. First, the RI determined that several waste deposits including portions of the East and West Hide Piles were in direct contact with the pond. Draining and filling the pond would effectively eliminate the potential for direct contact and future surface water quality impacts. The second reason is that the FS concluded that it was the most effective method for addressing and resolving the air pollution problems resulting from the East Hide Pile. The relationship between draining the wetland and the hide piles will be discussed in detail in the air pollution section of this document. For the purposes of evaluating this proposed remedial action it should be noted that limited water quality analysis conducted prior to and during the RI did not detect any significant present impact of the metal sludges on the surface water quality.

Because the draining and filling of the pond and its associated wetlands is included in every soils alternative except the no action alternative, S-1, it is important to address the applicable or relevant and appropriate Federal public health and environmental requirements in more detail now.

The presence of a wetlands is one of the most important environmental media requiring protection. A wetland serves many functions such as a habitat for water fowl, animals, plants and numerous species of aquatic life. In addition to serving as a habitat, wetlands act as nature's treatment system filtering out and trapping pollutants. While hardy in many respects, the continued good health of a wetland requires a fragile ecological balance. As a result, the Agency is committed to retaining, in their natural state, as many wetlands as possible. Section 404(b) of the Clean Water Act (CWA) is the statute governing the discharge of dredge and fill material into a wetlands. Primary authority for administering § 404(b) of the CWA rests with the Army Corps of Engineers (ACE). Section 404(b) addresses the discharge of dredge or fill into a wetlands; if fill is removed or dredged from the wetlands § 404(b) technically does not apply. Federal actions conducted in a wetlands which could potentially impact the wetlands is controlled under Executive Order 11990. Executive Order 11990 is much broader in scope than § 404(b) of the CWA. The executive order effectively prohibits any action from impacting a wetlands unless it can be demonstrated that no practical alternative exists to completing the required action. Any action ultimately undertaken involving wetlands must minimize to the extent practicable any adverse impacts to the wetlands. The criteria and requirements of § 404(b) are used during the implementation of the executive order. As noted above, several toxic metals deposits were in contact with the wetlands as well as portions of the East and West Hide Piles. Because of proximity of the wastes with the wetlands there exists no alternative which does not impact the wetlands. As stated earlier, the action of taking no action allows the continued release or threat of release of contaminants into the environment. All other alternatives would also impact the wetlands to some degree. If only the toxic metal deposits and not the hide piles were needed to be removed, then a practicable alternative would be the excavation of these materials from the wetlands thereby increasing the flood storage capacity of the wetlands - a positive impact. This action would comply with § 404(b) as it does not discharge dredge or fill material into a wetland and minimizes to the extent practicable the impacts to the wetlands, as required by the Executive Order

#11990. However, the disturbance or removal of the hide deposits would create the release of an obnoxious odor adversely impacting the surrounding community's welfare. Because the release or threat of release of this odor has created much concern within the community and nearby workers within the industrial parks the FS instead recommended the draining and filling of the wetlands. This alternative eliminated the need to disturb the hide piles, eliminated the potential for direct contact and assisted in the effective implémentation of remedial actions required for the air alternatives (specifically addressed in detail in the air section).

This alternative was found to be protective of the public health by eliminating the potential for direct contact. In addition, the alternative would meet Water Quality Criteria by eliminating any future impacts to the surface water. However, as noted above, the alternative does not meet or exceed applicable or relevant and appropriate Federal public health and environmental requirements. Clearly, the elimination of the pond and wetlands is in direct conflict with Executive Order #11990.

Post closure monitoring and maintenance would be consistent with RCRA regulations § 264.310, and §264 Subpart G concerning landfill closure and post closure and groundwater monitoring.

The implementation of this alternative uses sound and well tested construction techniques. However the availability of a suitable clay source in sufficient quantity and the installation of the cap around existing structures while maintaining an effective impermeable layer are two major concerns. The time required to implement this remedial action and the ability to bring sufficient quantity of material to the Site without a substantial disruption of local traffic are additional concerns. Proper maintenance and monitoring would ensure the effectiveness and reliability of the remedial action. The alternative does not make use of any techniques to reuse, minimize or destroy the waste material. Therefore, the cap system must be maintained and monitored indefinitely since in-situ physical, chemical, or biodegradation mechanisms are not expected to ever reduce the material to a non-hazardous classification. Finally, institutional controls would be imperative to ensure that future land uses did not disrupt the cover.
The useful life of a properly maintained clay cap is estimated to be greater than 50 years, at which time replacement may be required. The surface cap system is a reliable and well-demonstrated technology which prevents surface water infiltration through the buried waste material. Operation and maintenance requirements are not complex. They include long term groundwater monitoring, cap maintenance and mowing to maintain grass cover and prevent tree growth. The facility would have to be maintained indefinitely. The area of the site cap would not be available for future development. Deed restrictions would be required to enforce this provision.

The capital, operation and maintenance, and present worth costs of this alternative are summarized in Table 30. There are no identified site conditions or waste characteristics that would adversely impact the implementation or construction of this alternative at the site. However, there are several concerns which require resolution prior to implementation of the remedial action. The major adverse environmental impact under this alternative is the elimination of a wetlands. As discussed earlier in this alternative, the elimination of the pond and wetlands would not be required to meet the established objectives for the Site if it were not for the need to drain and fill the wetlands to control the problems associated with the East Hide Pile. These issues will be discussed in detail in the air section. Additional study during the Remedial Design (RD) for all the soils alternatives will be required to determine the specific impacts resulting from the dredging of the materials from the wetlands.

Another concern is the regrading of those areas of the Site where it is necessary for controlling Site drainage. This regrading presents the possibility of entraining contaminated soils in the air during construction. The clay and topsoil brought in also pose a potential threat of dust generation, both during construction and until the cap is fully vegetated. These cap materials also pose a threat of eroding sediments into the Site's surface waters during the same time period. These potential problems can be avoided and/or mitigated with strict enforcement of conventional dust and sediment control construction practices.

<u>S-3</u> <u>Cover contaminated soils containing any toxic metal in excess of 100 ppm in place with 6 inches of clay, 18 inches of common borrow, followed by 6 inches of topsoil and establish a vegetative cover.</u>

Alternative S-3 a is source control action similar in design and scope to the previous alternative. The only difference between the two is the thickness of the impermeable barrier. This alternative proposes to use 6 inches of bentonite clay material and 18 inches of common fill instead of the full 24 inches of bentonite clay proposed under S-2. Alternative S-3 would provide a similar degree of protection relative to the direct contact potential; however, it would not provide the same degree of reliability for impermeability as would S-2. The capital and operation and maintenance costs associated with S-3 are summarized in Table 31.

This alternative would meet the established public health response objectives for the Site. The surface cap system would effectively contain the soil/waste material and prevent contaminant migration, and as a result the potential for direct contact and accidental ingestion exposure would be eliminated. Conformance to applicable or relevant and appropriate Federal requirements is the same as that in S-2 and is discussed in more detail in the appropriate section of this document.

The primary advantage of S-3 over S-2 is the substantially lower capital costs, $13.25 million versus $23.6 million. The O&M and monitoring costs are equivalent and as a result the difference in present worth cost is slightly less than $10 million. While S-3 meets the remedial objectives established for the Site, the degree of added protection against infiltration under S-3 is substantially less than that for S-2. There are several reasons for this. Quality assurance and in-the-field application of bentonite are critical to ensure that the installation provides the degree of impermeability designed for. Typically, greater thicknesses, such as twenty four inches or greater, placed in several lifts, are necessary to minimize the potential of barrier failure. These failures usually occur as a result of placement, improper compaction or the clay cracking and shrinking as the moisture content comes to equilibrium once in place. Placement of a thicker layer, in three or four discrete lifts, eliminates most of these failures. A six inch thickness, placed in one lift, negates the benefits derived from the multiple lift technique. The resultant effect is the greater potential for infiltration and a lower reliability than in S-2.

The same concerns relative to the adverse impact to the wetland remain for this alternative as for the previous one. Likewise this alternative poses the same short term potential dust and sedimentation problems posed by S-2. Like all capping alternatives, S-3 does not recycle, reuse, minimize or destroy the wastes, and is dependent on perpetual O & M and institutional controls to ensure the efficacy of the remedial action.

<u>S-4</u> <u>Cover contaminated soils containing any toxic metals in excess of 100 ppm with 24 inches of common fill material, place 6 inches of topsoil and establish a vegetative cover.</u>

Alternative S-4 is a variation on S-2 and S-3, the only difference being that the twenty four inches of fill below the six inches of topsoil is clean borrow material instead of clay or clay and borrow material. As in other alternatives, institutional controls would be implemented as part of the alternative. The capital O&M and monitoring costs of S-4 are located in Table 32.

The use of this cover, even though it is permeable to surface water and rain water infiltration, would meet the established environmental and public health objectives for the Site. Placement of the cover material will effectively prevent the threat to, and provide adequate protection of the public health, welfare and environment resulting from the potential for direct contact. With the exception of compliance with Executive Order 11990, this alternative meets all applicable or relevant and appropriate Federal public health and environmental requirements.

Similar to S-3 and S-2, this alternative does not recycle, reuse, minimize, destroy or eliminate the waste material, only containing it on-site while eliminating the potential for direct contact. As a result, the remedial alternative will require continuing oversight and periodic maintenance indefinitely.

There are no identified Site conditions or waste characteristics that would adversely impact the implementation or construction of this alternative at the Site, other than those discussed under S-2 and S-3.

S-5 Cover contaminated soils with 20 mil PVC synthetic membrane, cover membrane with an additional 12 inches of common fill followed by 6 inches of topsoil and vegetate.

The intent of Alternative S-5 is similar to the previous three alternatives, which is to eliminate the potential for direct contact by placing cover material over the exposed or near surface deposits. Alternative S-5 uses a synthetic membrane instead of soil or clay to establish a protective barrier. Like S-2 through S-4, the pond abutting the East Hide Pile would be drained and filled.

Similar to S-4, S-3 and S-2, areas requiring remedial action under S-5 would receive Site preparation, including recontouring to promote drainage, prior to the cap installation. After this initial step, a six inch cover of screened sand would be compacted over the area. The purpose of the sand is to establish a stable and protective layer between the ground's surface and the synthetic membrane. The membrane, proposed to be 20 mil thick PVC, would then be placed on top of the sand. The membrane is delivered to the site in large rolled panels. Field installation includes placement of the panels and field seaming to join each panel together followed by an in-situ quality control check. Once the membrane has been placed, seamed and tested, it is covered by an additional six inches of sand. This layer of sand serves as a protective cover to prevent puncturing of the membrane and as a mechanism to drain off any moisture in contact with the membrane. The sand layer is followed by twelve inches of fill material and six inches of topsoil. Vegetation is established to control erosion. The additional cover material serves two purposes. First, it adds additional protection to the synthetic cover and second, it provides sufficient depth to minimize the effects of the freeze-thaw cycle.

Since the synthetic membrane is impermeable it provides the same added degree of protection against infiltration as does alternative S-2. The capital, operation and maintenance, and present worth costs are summarized in Table 33.

The implementation of this alternative uses proven engineering techniques. The operation and maintenance requirements are not complex and are similar in nature and scope to those found in Alternatives S-2 thru S-4. The application of Alternative S-5 offers several advantages over the previously discussed alternatives. The constructibility of this alternative is better than those alternatives which use clay to establish impermeability. Because the barrier is a synthetic product, it is manufactured under carefully controlled factory conditions. As a result, the quality and impermeability of the membrane can be more carefully controlled, resulting in an impermeability higher than natural materials. Field placement is easier to perform, less susceptible to inclement weather conditions and changes in the raw product. The disadvantages of using a synthetic material are the possibility of puncturing the liner during placement, the maintenance of quality control over field seaming, and the potential incompatibility of the membrane with the wastes or the susceptibility to attack from chemical contaminants. Another disadvantage of synthetic membranes is that they are relatively new for use in hazardous waste applications. As a result, their useful life has not been documented.

Alternative S-5 is protective of the public health and environment. As in the previous alternatives, minimization of potential for direct contact is the primary objective, and alternative S-5 meets this objective. In addition the installation of a synthetic membrane minimizes the potential of infiltration, thereby providing an additional degree of protection against leaching. It also meets all applicable or relevant and appropriate public health and environmental requirements except for Executive Order # 11990. It also poses most of the same dust and sedimentation concerns posed by the previous three alternatives.

The use of alternative S-5 would effectively contain the waste deposits and prevent future contact or contaminant migration. However the waste material to be capped would not be recycled, reused, minimized or destroyed, and therefore the cap must be maintained and monitored indefinitely since in-situ physical, chemical, biodegradation mechanisms are not expected to reduce the material to a nonhazardous classification. Institutional controls similar to those previously discussed would also be required to prevent disturbance of this remedial alternative.

<u>S-6</u> <u>Cover contaminated soils in place with six inches of topsoil and vegetate.</u>

Alternative S-6 consists of regrading portions of the Site to promote better drainage. Once the site has been regraded, six inches of topsoil will be placed over those areas where exposed deposits exist. Once the topsoil has been placed a vegetative cover would be established over the entire area. This alternative includes some limited excavation in the northwest corner of the Site along New Boston Street to minimize contact of wastes with the surface water. In addition, actions relative to the West and East Hide Piles (as previously discussed) are incorporated as part of this remedial alternative. The use of institutional controls would be needed in order to ensure that the remedial action was maintained as initially implemented. Capital costs and operation and maintenance expenses associated with this alternative are found in Table 34.

Implementation of alternative S-6 uses conventional and well established technologies. The alternative is relatively easy and straightforward to implement. The alternative is also attractive in that it provides minimum disruption to the local businesses and community during the implementation phase, since less material must be trucked into the Site.

The alternative meets the remedial objectives established for the Site, similar to the previous alternatives, but the degree of reliability is substantially less than those alternatives. The Operation and Maintenance (O&M) costs are higher to compensate for the decreased reliability. These two disadvantages can be related directly to the fact that the effects of the freeze-thaw cycle are much more pronounced on this alternative (six inches of cover material) than those alternatives using thirty inches of cover materials. As a result of only six inches of cover, the frost is permitted to penetrate to the actual waste deposits, thereby forcing wastes to the surface as the ground begins to thaw.

This occurrence significantly increases the potential for exposure of wastes to the public and environment. Another concern is that of erosion. Site conditions and surrounding land use patterns indicate a high potential exists for erosion to occur. The effects of erosion on a six inch cover will obviously pose a greater potential for release of contaminants than on a thirty inch cover. In order to minimize the potential for release occurring, the frequency of monitoring and routine maintenance for a six inch cover needs to be increased, hence an increased O&M cost. A second technique is to select and establish a vegatative cover which enhances the ability of the vegetative cover to minimize erosion. Again, this increases the operation and maintenance costs.

Alternative S-6 is protective of the public health, welfare, and environment since it meets the remedial objective of preventing direct contact with the public and surface water. This alternative has similar status with respect to applicable or relevant and appropriate Federal public health and environmental requirements as the previous alternatives, especially those employing permeable caps. An analysis of S-6 indicates that like the previous four alternatives it is a source control action which contains and controls future impact by using a long term in-situ cover. This alternative does not avail itself of new or innovative technologies. It provides an effective, if somewhat less reliable means of eliminating the potential for direct contact than the preceding alternatives with the exception of S-1. In addition, implementation does not pose any significant adverse environmental impacts over and above those noted in the previous four alternatives.

Alternative S-6 does nothing to recycle, reuse, minimize or destroy the wastes found at the Site. This alternative does not use new, innovative or alternative technologies to reliably minimize either the present or future threats to the public health, welfare or the environment.

S-7 Construct a RCRA on site containment facility. Excavate and deposit into the RCRA facility any waste deposit containing arsenic, chromium, or lead waste with individual concentrations of one or more exceeding 100 ppm, as well as the East Central, the West, and the South Hide Deposits.

Alternative S-7 evaluated the feasibility of excavating and relocating on-site all waste deposits containing heavy metals in excess of 100 ppm and all hide deposits except for the East Hide Pile to a hazardous waste landfill designed in conformance with the Resource Conservation and Recovery Act (RCRA). This would effectively contain Site contamination and prevent future potential migration of contamination associated with the Site. The technical performance of an on-site RCRA landfill is good compared to other containment technologies. A double liner, an impermeable cap, a leachate collection and storage system, and a leak detection system would prevent the migration of contaminants from the landfill. Any leakage through the first liner would be captured by the second liner and would be detected and collected prior to entering the groundwater. The useful life of a properly maintained RCRA landfill would be at least 30 years. The exact service life cannot be accurately predicted. However, the in-effect "triple" liner system would effectively eliminate the potential for release and therefore should provide for long-term waste containment. Site conditions are such that a minimum of ten feet would exist between the base of the landfill and the groundwater table. Long-term groundwater monitoring would also be provided. The various tasks associated with this alternative are indicated on the detailed cost estimate sheet, Table 35. It should be noted that the costs presented are underestimated because they represent the costs for consolidating wastes found on undeveloped property only.

Operation and maintenance requirements for an on-site landfill would be relatively complex. They would include groundwater monitoring, facility inspection and maintenance, and disposal/treatment of any leachate that may be generated from within the landfill.

Land use restrictions would be required for the area of the on-site landfill. No development would be allowed at the landfill site.

This alternative effectively mitigates the threat to, and provides adequate protection of public health and welfare and the environment and achieves the remedial objective for the site. With the exception of compliance with § 404(b) and the Executive Order 11990 this alternative exceeds applicable or relevant and appropriate Federal public health and environmental requirements since it also eliminates any potential for the wastes to leach contaminants into the groundwater. While regulatory permits would not be required implementation of S-7 would meet the technical requirements for new RCRA facilities. The impacts to the wetlands under this, as well as the other consolidation alternatives will be significant. Primary attention has been given to the wetlands located between the East and West Hide Piles; however, several smaller wetlands found on-site would be impacted under the consolidation options. As continually noted throughout the ROD, waste deposits are scattered over a large area often times in direct contact with wetlands and surface waters. Under the consolidation alternatives, the entire Site would be effectively excavated, eliminating existing wetlands and streams in the process. Implementation of the consolidation alternatives would not minimize the impacts to the wetlands it would eliminate them completely. Efforts would be required to compensate or create new wetlands once the proposed remedial action was complete.

Alternative S-7 minimizes area impacted and restricted. It uses more advanced technologies than previous alternatives to contain the wastes and eliminate the present and future threats to the public health or welfare or the environment. The use of a RCRA on-site facility would consolidate the waste deposits scattered over 90 acres to an area approximately 15 acres in size with satellite deposits under existing buildings, unless the buildings were removed. This alternative would result in a net gain in the amount of land not needing use restrictions.

There are several conditions that could adversely impact the implementation or construction of this alternative at the Site. The Site contains a number of existing buildings, roadways, and parking lots. In order for the remedy to be completely effective, waste deposits located under these existing structures would need to be removed in addition to those on the undeveloped portions of the Site. Allowing the wastes to remain in place under the buildings means leaving satellite deposits outside the RCRA containment facility, thus reducing the overall effectiveness of this alternative. From a practical standpoint there is no effective method for removing deposits underneath buildings without destroying or removing the buildings. Irrespective of these increases in the estimated costs, the disruption of existing businesses would also make this a difficult alternative to implement.

Further, while the east side of the Site (east of Commerce Way) appears to meet engineering criteria for the siting of a RCRA landfill, the relatively high groundwater table and a major wetlands adjacent to the proposed facility would adversely impact the implementation of this alternative. A waste compatibility evaluation would also be required during the design of the RCRA landfill to ensure compatibility between the waste deposits and the liner system.

Additional impacts resulting from the implementation of this alternative would include the short term generation of dust, odor and sedimentation problems similar to those noted in previous alternatives. Impacts to the wetlands between the Hide Piles would be similar to those previously mentioned, however the wetlands east of Commerce Way would also be impacted by this alternative. The amount of fill material, such as clay, necessary to construct the RCRA facility would need to imported from off-site. This would place a substantial burden on the local traffic flow patterns (which are currently stretched to capacity now). Implementation of this alternative would require that clean uncontaminated land slated for development would be unavailable for future development as a result of this alternative. In addition to all the adverse impacts resulting from this alternative, the alternative does not recycle, reuse, minimize or destroy the wastes materials.

In addition to the logistical and implementation problems noted above, there are several short term adverse impacts associated with implementation of this alternative. The RI determined that approximately fifteen percent of the sludge deposits are contained within the saturated zone. In addition, local surface waters are found in contact with the waste deposits at several locations. Excavation of the deposits will tend to suspend a portion of the waste material in the ground and surface waters. While engineering technique can be implemented to minimize these potential impacts, the sheer volume of wastes to be excavated in order to successfully implement these alternatives, make the potential for a short term release very high.

Further, a significant amount of the material requiring removal as part of these alternatives is the animal glue manufacturing deposits. Past experience with the primary developer (Mark Phillip Trust) indicates that disturbance of these deposits will cause a substantial release of odors. Release of these odors will pose a significant adverse impact to air quality surrounding the Site. Historical information indicates that during active excavation of the hide deposits, the odor emanating from the Site was pervasive throughout the surrounding communities. Continuous complaints of the obnoxious odor, severe headaches and nausea were reported to the State regulatory agencies. Reports of workers becoming physically ill are contained in past reports. Strong public reaction from the recipients of the odor resulted in the Town of Reading suing the developer to cease and desist generating the odors. A number of techniques were experimented with in an effort to control the odor, none of which was successful. In the six years since the active excavation, odors can still be detected under certain circumstances as a result of the disturbance of the deposits. As a result of the adverse impact to the welfare and the strong public resistance, the removal or rearrangement of the hide deposits is not feasible.

S-8 Remove all arsenic, chromium, and lead deposits with individual concentrations of one or more exceeding 100 ppm and consolidate these deposits on the East Central/ East Hide deposits areas, backfill excavated areas with clean fill material and cover the East Central and East Hide Deposits with impermeable cover.

The FS evaluated the feasibility of consolidating approximately 90 acres of deposits containing elevated levels of arsenic, chromium, and lead into an approximately 15 acre area on the northern border of the site. Implementation of this alternative involves the removal of approximately 460,000 cubic yards of waste deposits and their consolidation into one large deposit. The consolidated deposit would then be covered with a cap similar in design to that found in alternative S-5. Capital costs, operation and maintenance and present worth costs can be found on Table 36. For the same reasons as were discussed for alternative S-7, these costs are underestimated.

Once completed, Alternative S-8 is protective of the public health, welfare and environment. It eliminates the potential for direct contact between the wastes and the public and surface waters. It will not provide the same degree of protection as the previous alternative, S-7. The advantage of the previous alternative S-7 was that once the waste was removed from the present location it would be placed in a secure RCRA landfill. Under alternative S-8 the waste would be consolidated to an area which presently contains waste deposits. The physical handling of the material and the placement of it on top of existing waste deposits may in fact cause more adverse than beneficial environmental effects. Similar to the animal glue wastes which were not generating substantial odors until some of the deposits were disturbed, creating the East Hide Pile and its subsequent release of odors, the physical relocation and restructuring of the deposits to a new area may create a situation that promotes the potential for increased leaching of the wastes. Implementation would not meet applicable or relevant and appropriate Federal public health and environmental requirements. Implementation of this alternative would have significant adverse impacts on surface water quality, the elimination of a wetlands and the release of an obnoxious odor. In addition, impacts to the wetlands and concerns about compliance with the appropriate requirements are similar to those discussed in S-7.

This alternative has several of the advantages associated with alternative S-7 but without the increased cost of constructing a RCRA facility or of moving Hide Piles. Like S-7 this alternative consolidates the wastes onto a smaller parcel of land (15 acres versus 90 acres), thus minimizing the amount of land that must be maintained, monitored and restricted from development. Because of the reduction in physical size there will be a reduction in O&M costs. In addition this alternative, unlike S-7, would consolidate the contaminated materials on property that is already contaminated. The physical removal of the material and its consolidation onto another portion of the property would use standard earth moving techniques that have proved effective in this kind of operation. This alternative has a substantially lower capital cost and is easier to implement than the previous alternative S-7. The alternative is similar to previous alternatives in that it seeks to control the potential for direct contact potential through containment rather than recycle, reuse, minimize or destroy the waste.

Implementation of this alternative could cause several adverse environmental impacts. The physical removal and relocation of approximately 460,000 cubic yards of waste deposits would impact the local groundwater, surface water, and eliminate several wetlands found on-site. This quantity of material to be moved will require a substantial earthworking effort. Because a substantial portion of the waste materials are in direct contact with ground and surface waters, the heavy equipment will need to intrude into these media in order to remove the wastes and eliminate the direct contact. Despite using every available technique to lessen the impacts to surface and ground waters, nonetheless an impact will occur. In addition, issues similar to those found in alternative S-7 involving excavation under existing structures would be applicable to this alternative. The alternative proposes to backfill the excavated areas with clean fill material. In addition to the large amount of traffic to physically remove the waste deposits for waste consolidation, there would be a significant traffic impact on the surrounding community as a result of the large amount of clean fill required from off-site to backfill the excavated areas.

<u>S-9</u> <u>Remove all arsenic, chromium, and lead deposits with individual concentrations of one or more exceeding 100 ppm; consolidate on the East Central/West Hide Deposits; and cover the East Central and West Hide Deposits with an impermeable material; and leave excavated areas unfilled.</u>

Alternative S-9 is exactly like alternative S-8 except that the excavated area would not be backfilled with fill material. The primary advantage of this alternative over the previous alternative is a substantal decrease in the capital costs. The capital, operation and maintenance costs and present worth costs of this alternative are summarized in Table 37. Again, for the reasons previously noted, these costs are underestimated.

This alternative could be successfully implemented with the application of standard engineering and construction techniques. Site conditions do not pose any significant adverse impacts to the implementation of this alternative, however the concerns to those noted in alternative S-8 relative to the material under existing structures and impacts to the environment also apply to this alternative.

The primary advantage of this alternative is that it costs approximately half that of alternative S-8 in terms of both money and implementation time. The primary disadvantage to this alternative would be that, without the clean backfill, open excavations up to 15 feet deep would be left behind once the Site remediation was completed. Allowing these excavations to remain is not practicable as they would create an attractive nuisance to area children and would leave the area pock marked by numerous shallow ponds or ditches. On the other hand, the land would be clean and hence developable. These ponds would be no worse to deal with than common development problems like high groundwater or bedrock.

S-10 Fence areas of waste deposits, enforce institutional controls; excavate limited area in northwest corner of site; cover the East Central and West Hide deposits.

Alternative S-10 involves the limited excavation of waste deposits from one of the developed properties, PX Engineering, to eliminate the direct contact between these deposits and the surface water. This excavated material would be transported to the East/West Hide Piles area. The East Central, and East and West Hide Pile areas would be regraded and reshaped to promote better drainage. In addition the South Hide Pile would be relocated to the West Hide Pile area in order to fill low spots and help stabilize side slopes. The area which was reshaped and regraded would be covered with a six inch topsoil cover and vegetative growth established. The remaining deposits would be fenced to prevent unauthorized access, and institutional controls would be enforced throughout the entire site to ensure that the remedial action was not disrupted. The capital, operation and maintenance, and present worth costs are summarized in Table 38.

This alternative may not meet the environmental and public health goals established for the Site. The alternative does not effectively prevent, mitigate, or minimize the threats to, and provide adequate protection of the public health and welfare and the environment.

Presently there exist a number of areas within the Site where exposed deposits present a direct contact threat. Under this alternative the barrier between the waste and the public would be a fence. Past experience at this Site indicates that fencing is ineffective in eliminating entry and the potential for direct contact. In the five years since the initial installation of the fence, the Agency has made repeated attempts to repair damage to the fence resulting from vandalism. Implementation of this alternative would permit the continued release or threat of release to the environment of the waste deposited on the Site.

In addition the presence of exposed deposits creates the possibility of their erosion by precipitation runoff, adversely impacting the surface water and ultimately the groundwater found on-site.

This alternative does not meet the applicable or relevant and appropriate Federal public health and environmental requirements. Because exposed deposits would be allowed to remain in direct contact with surface waters the release or threat of release of contaminants would violate Water Quality Criteria. The initial placement of the East and West Hide Pile in or near a wetlands was in violation of the Clean Waters Act §404(b); leaving them in their current state would continue to violate § 404(b). This alternative is extremely simple to implement because this alternative approaches no action. Because the alternative takes only limited actions, the actions are easily constructed. Unfortunately, as previously stated these actions are ineffective in preventing unauthorized access to the Site; thus the actions have to be considered unreliable.

The capital cost is obviously low since S-10 entails only placing fences around the area after limited consolidation, reworking and capping some portions of the Site.

Alternative S-10 does nothing to recycle, reuse, minimize or destroy the wastes found at the Site. This alternative does not use new, innovative or alternative technologies to reliably minimize either the present or future threats to the public health, welfare or the environment.

Implementation of this alternative, like S-1, does not take additional actions in or near a wetlands. As a result there would be no additional adverse impacts resulting from remedial actions. However, the potential does exist over the long term however, for exposed deposits to impact the local surface water as a result of storm water runoff and erosion. This alternative does nothing to minimize these potential problems.

<u>S-11</u> <u>Cover all waste deposits with 24 inches of off-site fill, followed by 6 inches of topsoil and establish vegetative cover on waste deposits with arsenic values greater than 300 ppm, lead values greater that 600 ppm, and chromium greater than 1000 ppm. Cover the East Central and the West Hide Deposits. Impose institutional controls on the property.</u>

Alternative S-11 is similar to alternative S-4, with respect to the construction details of the cover, i.e. twenty-four inches of permeable material followed by six inches of topsoil. There are several important differences between this alternative and S-4, as well as the other alternatives. Most notably the action levels have changed from an arbitrarily established value of 100 ppm to values developed in the Endangerment Assessment (EA). In addition, previous alternatives addressed covering any deposit exceeding 100 ppm, irrespective of the depth below grade at which the waste was detected. In S-11 the alternative seeks to eliminate the potential for direct contact with any deposit above the action levels established in the EA that could become exposed as a result of the freeze-thaw cycle or effects from erosion. This objective is accomplished through the use of a permeable cover over deposits exceeding the action level that are within thirty inches of the ground's surface. Institutional controls would be implemented to control any area having deposits exceeding the action levels regardless of depth. For contaminated materials located in areas where buildings, parking lots and roadways currently exist the structure itself would serve as the barrier to eliminate the potential for direct contact. As in other portions of the Site, institutional controls would be implemented to restrict disturbance of the effectiveness of the remedial action. The premise of this alternative is to establish a thirty inch zone of uncontaminated material over the waste deposits to eliminate the potential for direct contact, minimize the effects of the freeze-thaw cycle and help control exposure resulting from erosion.

This alternative, S-11, utilizes remedial action levels established by the EA. A discussion of the action levels can be found in the current Site status section of this document and in Appendices F and G of the FS. In addition to the EA performed as part of the FS, another potentially responsible party (PRP), Monsanto Chemical Company, retained a consultant to independently assess the potential risk posed by the Site. Results from this independent analysis were similar to those found in the FS. Both the EA found in the FS and the independent risk assessment were submitted to the Department of Health and Human Service's Agency for Toxic Substances and Disease Registry (ATSDR) for their review and comment in the form of a Health Assessment. ATSDR's review and interpretation of the data was based on a literature review as well as empirical data gathered from several studies conducted by the Centers for Disease Control (CDC). The values determined to be protective of the public health by ATSDR were similar to those found in the EA and the independent analysis. However ATSDR concluded that safe levels for an industrial setting could be an order of magnitude (factor of ten) higher than those determined to be protective of the public health in a residential neighborhood. As a result, ATSDR concluded that maximum acceptable surface soil residues of 6,000 ppm Arsenic, 10,000 ppm Lead and 30,000 ppm for trivalent Chromium were appropriate for this Site, assuming the exposure was the type to be encountered in an industrial setting.

The Agency reviewed and evaluated ATSDR's Health Assessment and rejected their use of an arbitrary increase by an order of magnitude in projecting safe clean-up levels. As previously noted, if the order of magnitude increase is eliminated, ATSDR's values are similar to those calculated in the FS and Monsanto's risk assessment. The Agency does not believe that final determination of clean-up levels should be based, in a large part, on the projected use of the Site. While a portion of this Site is currently an industrial area, the remainder of the Site receives a fair amount of recreational use. Hunters, berry pickers, and motorcyclists are often discovered using the Site. Under the proposed remedial action a portion of the Site would remain undeveloped and as a result, these activities are likely to continue. Since at least a portion of the Site would remain undeveloped under all but two of the remedial action alternatives and therefore an attractive area for adolescents and others to frequent, it is prudent to assume that the potential for exposure is substantialy higher than if the Site were truly an industrial area. It could reasonably be argued that as the land around the Site becomes more industrialized, the Site would become more attractive for recreational use because open space would be that much rarer in this section of the City. The Agency therefore concludes that the action levels established in the EA, not ASTDR's, are protective of the public health, welfare and environment and provide a greater margin of safety given the uncertainty of future land use patterns around the Site.

In addition, the ATSDR Health Assessment is limited to issues directly related to the protection of public health; it does not address levels protective of the environment. As discussed in the EA and in connection with the no action alternative, the arsenic deposits are phytotoxic at levels as low as 300 ppm. Further, the East Hide Pile has a very sparse vegetative cover despite the fact that the last earth moving there ceased seven years ago. This fact supports the relationship between elevated levels of metals and phytotoxicity.

The associated capital, operation and maintenance, and present worth costs for this alternative can be found in Table 39. The primary advantage of this alternative over S-4 are the lower capital and O&M costs resulting from the decreased area requiring remedial action.

Alternative S-11 meets the environmental and public health goals established for the Site. Present and future potentials for direct contact are eliminated by the installation of a permeable cover and institutional controls. In addition the alternative meets the applicable or relevant and appropriate Federal public health and environmental requirements for the Site.

S-12 Cover the East-Central and West Hide Deposits and all waste deposits with values greater than 300 ppm arsenic, 600 ppm lead, or 1000 ppm chromium with six six inches of topsoil and vegetate. Impose institutional controls on property.

Alternative S-12 uses the same action levels and depth criterion as S-11, but replaces the twenty-four inch cover in S-11 with a six inch cover like that used in alternative S-6. Like S-11 institutional controls would be needed to prevent disruption of any deposit exceeding the action levels regardless of the depth at which it is found. Cost evaluation can be found in Table 40. Evaluation in terms of engineering implementation and constructibility is the same as with the preceeding alternative. Alternative S-12 meets the remedial objective for soils contamination since it would effectively eliminate direct public contact with wastes exceeding the action levels. As discussed regarding S-6, the six inch cover is readily constructed using conventional engineering techniques. This alternative would be easier to implement because less land, forty-three acres versus seventy acres, would require covering. The smaller area reduces the amount of topsoil that must be brought to the Site, thereby reducing traffic impacts and disruption of the surrounding community. Implementing this alternative poses no long term adverse environmental impacts and poses only minimal construction related impacts, primarily the potential for generating dusts and causing sedimentation of surface waters. These are easily dealt with.

As with S-6, the thinness of the cover proposed here makes it a less reliable remedial action than the thirty inch covers proposed in other alternatives. The six inch cover would be much more susceptible to disruption by erosion and the freeze-thaw cycle. Since this alternative is a containment action, it does not recycle, reuse, minimize or destroy the wastes and contaminated soils.

This alternative has similar status with respect to applicable or relevant and appropriate Federal public health and environmental requirements as the previous alternatives. Based on its lower reliability and higher action levels this alternative while meeting the remedial objective for soils at the Site is less protective of the public health and the environment than all other alternatives except S-1 and S-10. The capital, operation and maintenance, and present worth costs for this alternative are summarized in Table 40.

S-13 Remove all arsenic, chromium, and lead waste deposits with individual concentrations of one or more exceeding 100 ppm and remove the East Central, the West, and South Hide Deposits to an off-site location. Backfill excavated areas with clean off site fill material.

This alternative, S-13, evaluates the off-site disposal alternative. Under this alternative all materials above 100 ppm located on undeveloped land would be excavated and trucked off-site for disposal at a RCRA landfill. The majority of the Site would be effectively cleaned up and the wastes disposed of at an off-site RCRA landfill.

The costs of this alternative are presented on Table 41. The associated capital costs are approximately 210 million dollars. Detailed evaluation was not conducted in the FS because its costs far exceed those of the other alternatives without substantially increasing the protection of the public health and environment. Since there are other alternatives that meet the remedial objective and the requirements of other Federal public health and environmental requirements, this alternative is not substantially more effective than other viable alternatives. This alternative is substantially more reliable than other alternatives as evidenced by there being no operation and maintenance costs or institutional controls associated with it. For this reason the Agency will analyze this alternative here.

This alternative is constructable, but the implementation time is extremely long. The FS estimated that it would take approximately seven years of constant soil removal to effectively remove this amount of material. This would severely disrupt traffic and businesses around the Site.

In order for these alternatives to be completely effective, all the waste deposits would need to be excavated and redeposited into a secure facility. This alternative was evaluated in terms of excavating and removing wastes from undeveloped portions of the property. Areas containing buildings, parking lots or roadways were not included as part of this alternative for reasons noted previously. The physical problems and logistics associated with waste removal from under these structures is costly and impractical. Assuming that these deposits are allowed to remain in place, the effectiveness and driving force behind this alternative is substantially reduced.

If all deposits are to be removed, these buildings would have to be taken down, parking lots and lawns excavated and the wastes removed. As a result, a complete removal would cost more than the $210 million estimated in the FS.

The logistical and odor problems discussed previously in connection with alternative S-8 apply to this alternative as well.

This alternative would effectively eliminate any long term public health, welfare, or environmental impacts through the removal of the waste deposits to an off-site facility.

D. Development and Screening of Alternatives for Air

The remedial actions required to abate air problems center around the East and West Hide Piles.

The East and West Hide Piles are large mounds of glue manufacturing wastes and heavy metal sludges that are built out from the sides of hills on the east and west sides of a pond located in the northwest section of the Site. The piles extend from the hillsides across a wetlands and into the pond itself.

The West Hide Pile is relatively stable and is almost entirely covered with vegetation, primarily reeds. There are exposed metals deposits on the West Hide Pile at the base of the slope where it meets the pond. The East Hide Pile is larger, has unstable side slopes and has almost no vegetation covering it.

Sections of the East Hide Pile have sloughed off into the wetlands, simultaneously releasing strong, obnoxious odors. The RI determined that the East Hide Pile is the source of the odors emanating from the Site. It also has several intermittent leachate seeps that impact the wetland.

Since the RI determined that the West Hide Pile was not an odor source, the remedial objectives for this pile are to maintain stable side slopes and to eliminate the potential for direct contact. Therefore, the West Hide Pile remedial action alternatives were evaluated as part of the Soils section of the FS.

The remedial action objectives for the East Hide Pile are:

1) to eliminate the potential for direct contact with the heavy metal wastes;

2) to stabilize the side slopes in order to eliminate sloughing of materials into the wetlands, and
3) to eliminate the emission of obnoxious odor into the ambient air.

For convenience, the RI/FS discussed all the problems with the East Hide Pile as "odor" problems. Similarly, this document will discuss all the remedial alternatives for this problem as "air" alternatives.

The evaluation of the potential air remediation techniques consisted of two parts. The first was an evaluation of various techniques to stabilize the side slopes, to eliminate the potential for direct contact and collect the odorous gases. The second evaluated several treatment techniques which would either eliminate the potential generation of gases or treat the gases being released to the environment. Listed below are the alternatives initially screened for potential use at the Site.

AIR ALTERNATIVES

- No Action

Gas Collection and Control Alternatives

- Construct a passive gas collection system
- Construct an active gas collection system
- Installation of a tall stack
- Construction of a cap system consisting of either an impermeable membrane liner, clays, soil admixtures, asphalts, or urea-formaldehyde materials.

Gas Treatment Alternatives

- Vapor Phase Adsorption
- Carbon adsorption treatment system
- Ion exchange resin treatment system
- Thermal Oxidation
- Installation of flare or afterburner
- Stabilization
- A pH adjustment using sodium bicarbonate or lime to expedite the transition of the East Hide Pile from an active to passive emission source
- Chemical Oxidation
- Addition of hydrogen peroxide or ozone to reduce odor emission

Each alternative was evaluated for its ability to either contain and control the gaseous emission or eliminate the formation of the odor in the first place. The following is a brief discussion of each alternative.

The use of urea-formaldehyde barriers to contain the gaseous emissions was evaluated and eliminated based on acceptable engineering practices. The use of foam to eliminate exfiltration of gases is dependent on its permeability. A review of available information indicated that the effective permeability of the foam varied widely as a result of frequently encountered installation problems.

The use of a tall stack dispersion as a technique was eliminated based on effectiveness. The location of several major high power electrical transmission lines makes the placement of a tall stack in close proximity to the lines infeasible. Furthermore, the use of a tall stack would not prevent or eliminate the release of odors; it would minimize their impacts through enhanced dispersion. While there are advantages to maximizing the dispersion and resulting assimilation of a plume into the environment, enhanced dispersion techniques are not recognized by DEQE or EPA as good engineering practice since they do not reduce pollutant mass.

The use of chemical oxidation to eliminate odors was eliminated based on effectiveness. The use of an oxidizer, such as hydrogen peroxide or ozone, has the potential for generating a hazardous waste as a byproduct of the reaction. This is because the oxidation reactions frequently are not complete, leaving an oxidation product which could be in a more toxic form than the initial compound which would create a significant adverse environmental impact.

Ion exchange as a treatment technique for odors was eliminated based on acceptable engineering practices because it is not an appropriate technique for the treatment of the type of air emissions found at the Site.

The physical removal of the East and West Pile was eliminated based on cost, acceptable engineering practices and effectiveness. The East Hide Pile, determined to be the primary source of odors, was created from the relocation of other hide deposits on-site during Site development. During the excavation of several building foundations, the odor was at its worst. Numerous techniques were implemented to attempt to reduce the odor while still permitting Site development. All efforts to contain odors during excavation and removal failed. Since on-site activities have ceased, the odors have abated significantly, only being detected when one of several conditions, such as changes in barometric pressure, occur. The costs associated with removal of the pile far exceed the costs of other alternatives evaluated ($36 million versus $2.8 million) and the alternative does not provide substantially greater public health or environmental protection. Excavation and removal of the piles would destroy a wetlands during the actual removal. In addition, a substantial impact to the abutting surface water would occur causing serious sedimentation and degradation of water quality. Currently there are no acceptable engineering technologies capable of controlling the release of odors during the excavation of these materials. As a result, there would be a significant release of odors. Workers involved in the excavation and removal would be exposed to concentrations of hydrogen sulfide and methane gases in excess of allowable occupational exposures. Therefore there are no acceptable engineering practices for avoiding these adverse environmental and occupational problems.

The use of lime or sodium bicarbonate as a stabilization technique received an initial evaluation. The technique would involve the injection of a solution into the pile which would raise the pH to a level which would stop the microbial decomposition, a major factor in the generation of odor. The use of this technique was eliminated based on effectiveness. Like grout curtain wells, injection of a stabilization slurry is highly dependent on waste material characteristics and the number and location of the injection points. In addition, use of this technique has not proven effective in reducing emission rates from sanitary landfills.

E. Detailed Analysis of Air Alternatives

Six alternatives, including the no action and total removal alternatives, remained after the initial screening process and were evaluated in detail for use at the Site. The remaining alternatives were subjected to a detailed analysis consistent with § 300.68(h) of the NCP.

Again, for ease of reading, the alternatives as discussed in this document will be renumbered from those found in the RI/FS. The changes are summarized below:

New Number	Old number found in RI/FS
A-1 Shall be considered the No Action Alternative	Not specifically addressed in FS as a discrete remedial action
A-2	Alternative I page 43
A-3	Alternative II page 43
A-4	Alternative III page 43
A-5	Odor Control portion of alternative V located in Appendix I.
A-6	Odor Control portion of Alternative II listed in Appendix I.

A-1 No Action Alternative.

Similar to the alternatives evaluation for groundwater and soils, a no action alternative for air was not specifically addressed in the FS. As a result, a brief analysis of this alternative is summarized here.

The emission of obnoxious odors caused by hydrogen sulfide (H_2S) and other reduced sulfur compounds resulting from the anaerobic decomposition of the glue wastes has been a continual source of disturbance to the neighboring communities and has thus been viewed as posing an adverse impact to their welfare.

In the course of the RI it was determined that the odor threshold for H_2S was between 0.02-0.15 ppm for ambient conditions. Based on air modelling conditions found in Appendix C of the FS, it was calculated that H_2S concentrations found at the nearest residential area under worst case conditions would approach 0.187 ppm. Even at three kilometers downwind of the Site under current conditions (i.e., no excavation), H_2S concentrations would exceed the lower detection level, allowing odors to impact the public welfare.

Implementation of the no action alternative (A-1) would have no capital costs associated with it. The FS estimated $18,000 per year for a quarterly air monitoring program, resulting in a present worth cost of approximately $171,000. If implemented the alternative would permit the East Hide Pile to continue emitting obnoxious odors containing H_2S. In addition to the emission of odors, the physical disposition of the East Pile causes several additional impacts. The pile was initially placed in a wetlands and as the pile increased in size, it further encroached on the pond and its associated wetlands. Presently the pile has unstable side slopes which result in occasional sloughing of contaminants into the pond and adjacent stream. In addition, as a result of inadequate cover material, precipitation continues to percolate through the pile causing leachate breakouts to impact the local surface water. These leachate breakouts were observed following rainfall events and were sampled as part of the RI. While analysis of surface water exiting the pond conducted as part of the RI does not indicate a significant adverse impact, clearly the potential for future impacts exists as the pile continues to decompose, causing additional contaminants to be released to the wetlands.

Because of the previously mentioned lack of adequate vegetative cover, large erosion gullies are evident on the sides of the pile, as the slopes moderate, the displaced soils begin to form deltas in the wetlands. Together with the decomposition of the organic matter in the pile this erosion is a contributing factor to the sloughing of material into the wetland. The implementation of this alternative is simple and straightforward as it only requires development and implementation of a monitoring program.

This alternative does not meet the applicable or relevant and appropriate Federal public health and environmental requirements. Continued leaching and sloughing of the pile would further impact surface water quality and the wetlands in violation of the Federal Clean Waters Act (CWA). Furthermore, the NCP permits that State standards can be considered by the Agency in selecting remedies at Superfund Sites. The Agency believes that in this instance the Massachusetts Regulations for the Control of Air Pollution, and specifically its regulation (310 CMR 7.09) prohibiting the release of odors into the ambient air is both relevant and appropriate for use at this Site. (The reader is referred to the section on Consistency with Other Environmental Regulations for more detail supporting this decision). As previously discussed, the pile continues to release odors even when there has been no excavation or sloughing occurring at the time.

It is important to note here that under the terms of their Consent Order, Stauffer Chemical Company, the Agency and DEQE have agreed that "odors originating on the Site... shall be deemed and addressed in the same manner as 'Hazardous Substances'" as defined by CERCLA. It is also important to note that under the existing § 106 Administrative Order, Stauffer is obligated to treat the odors as hazardous substances and is obligated to implement or reimburse the Government for the costs of remedial actions to abate the odors.

Selection of the no action alternative would continue to permit odors to be released impacting the environment and the surrounding community's welfare. Continued leaching and sloughing of the pile would further impact the wetlands. The no action alternative does not involve any techniques which minimize, degrade or recycle the waste.

<u>A-2</u> <u>Dewatering, slope modification, installation of synthetic membrane, topsoil and vegetation.</u>

Alternative S-2 utilizes several standard engineering techniques to stabilize the pile and reduce the odor potential. Specifically, A-2 would reduce the mounded groundwater table within the pile using two methods. The first involves installing a 60 inch drainage system to dewater the pond and depress the local groundwater table. Once drained the pond and associated lowlands would be filled in order to establish a base for slope modification and recontouring. Clean fill and fill from the South Hide Pile will be used to establish a three to one side slope on the pile. Recontouring and shaping of the original pile would be kept to a minimum in order to minimize the release of odors. Following the stabilization of the pile, a six-inch layer of sand, which will serve as a bedding layer, will be placed over the pile. A 20 mil thick PVC synthetic membrane will be placed to form a cover impermeable to gases and liquids over the waste deposit. This synthetic membrane is the second step to reduce the mounded groundwater table within the pile. On top of the membrane another six inches of sand followed by six inches of topsoil will be placed to complete the remedial action. A vegetative cover and surface water control and diversion structures will also be included as part of the cover design.

The RI determined that the generation of odors is controlled by five factors: moisture contained within the pile, anaerobic decomposition of the organic material within the pile, sloughing of side slopes, gas migration via pore spaces, and rapid changes in barometric pressure. A-2 seeks to control four of the five factors by dewatering the pile, utilizing the synthetic membrane to prevent gas migration and precipitation infiltration, lowering the local groundwater table by dewatering the pond, and stabilizing the side slopes to prevent sloughing. A-2 does not involve any gas venting and/or treatment system, nor does it attempt to prevent decomposition of the wastes. The capital, operation and maintenance and present worth costs are summarized in Table 44.

This alternative meets the environmental and public health goals for the Site by reducing the potential for direct contact, odor generation and degradation of the wetlands and surface waters. The techniques used to obtain these objectives involve standard civil engineering techniques and have an expected useful life of 50 years. Operation and maintenance costs and efforts are similar to those involving soil capping alternatives. There is nothing in the characteristics of the wastes which would adversely impact the alternative.

Results of the RI indicate that the air emissions from the East Hide Pile are adversely impacting the ambient air quality at and around the Site, but are not currently presenting a threat to public health and the environment. The continued emission of the H_2S and the other reduced sulfur compounds, with their attendant odors, are adversely impacting the public welfare. In addition to eliminating the potential for direct contact and the impacts to the surface water the remedial actions taken to abate the odors would also be addressing a threat to the public welfare.

Alternative A-2 does not propose remedial actions to actively eliminate the potential release of odors. Under this alternative, elimination of odor potential relies on elimination of moisture to interrupt the anaerobic decomposition cycle and on the impermeable cap to trap the gases that are generated. Since it is difficult to predict the relative importance of each factor in the release of odor, the elimination of moisture from the pile may not provide the degree of reliability necessary to eliminate the odor. Further the synthetic liner, while impermeable to the gases, will be tied into relatively permeable materials at the base of the pile. Trapped gases may escape into the ambient air via this pathway. Elimination of the odor's adverse impacts on the welfare of the surrounding community is considered a major component to the successful resolution of the Site's problems.

This alternative does not use recycling, reduction or destruction as a technique to minimize or eliminate the problems. The alternative uses containment and monitoring as the means to achieve the remedial objectives. Implementation of this alternative would also produce an adverse environmental impact. Under this alternative the FS indicates that the abutting wetlands would need to be drained and filled as part of the remedial plan. The elimination of wetlands is prohibited under both § 404(b) of CWA and Executive Order 11990 unless it can be shown that no other practical alternative exists. In the event that a wetlands requires filling, mitigation techniques must be implemented to compensate for the eliminated wetlands. The FS indicates that a substantial portion of the groundwater mound results from the high groundwater table and artesian-like conditions within the pile. Lowering the localized groundwater table by draining the wetlands will reduce this mound. The remaining reduction will result from the synthetic membrane. In addition, the FS concluded that the drainage of the wetlands was necessary in order to establish a good base for building the necessary three to one side slopes.

The alternative uses standard engineering practices in implementation of the remedial action. Implementing it is simple and straightforward. Care must be taken in field seaming the synthetic membrane and in checking the integrity of the installed membrane.

The overriding disadvantage of this alternative is that it destroys the wetlands. A second disadvantage would be the possible failure of the membrane resulting from gas pressure building up beneath it, rupturing the liner. Another possible disadvantage is that even if the membrane does not rupture the pressurized gases may travel laterally out from under the edges of the membrane and ultimately enter the ambient atomsphere.

<u>A-3</u> <u>Dewatering, slope modification, installation of synthetic membrane, gas collection and treatment utilizing carbon adsorption, topsoil and vegetate.</u>

A-3 is exactly like A-2 except that A-3 includes installing a gas collection and treatment system.

Prior to the installation of the synthetic liner a gas collection system consisting of a series of six inch diameter PVC pipes bedded in a twelve inch layer of gravel will be installed. These pipes will be manifolded together to form a header pipe which is connected to a blower system. The blower system discharges into the influent of a treatment system. The treatment system proposed in A-3 consists of two stainless steel tanks connected in series containing activated carbon. The odor containing air would be passed through an activated carbon filter especially treated to remove H_2S and mercaptans. The use of a specially treated activated carbon makes this an effective technique. The effectiveness of carbon adsorption is dependent upon the polarity of the compounds to be removed. For example, nonpolar organics such as benzene adsorb well. Hydrogen sulfide, however, is polar and as a result, tends to be absorbed well on standard activated carbon. The removal efficiency of carbon adsorption for hydrogen sulfide can be increased by impregnating the carbon with metal oxides. Several types of carbon can be used dependent on influent conditions. A Calgon metal impregnated activated carbon, specially formulated for H_2S and mercaptan adsorption in oxygen free atmoshperes, Type FCA, could be used to adsorb emissions from a passive gas vent. However, the low emission rate would not ensure equal distribution through the carbon, increasing the likelihood of early odor breakthrough. Therefore, a passive venting system is unsuitable for carbon adsorption.

Another type of Calgon carbon specially treated for H_2S and mercaptan adsorption in the presence of oxygen, Type IVP, could be used with an active venting system. Introduction of air would ensure good distribution through the carbon bed thereby prolonging the useful life of the system, reducing methane concentrations below the 5-15 percent explosive range, and providing the oxygen atmosphere required for IVP adsorption. Carbon may also act as a catalyst to oxidize hydrogen sulfide. Selection of the most appropriate type of carbon, sizing of the system and other operating parameters will need to be defined as part of the remedial design.

The effluent from the carbon treatment would be vented to the atmosphere. If activated carbon treatment is chosen to remove H_2S, mercaptans, and volatile organic compounds (VOC) from the East Hide Pile, a monitoring plan should be developed in the design phase to determine when breakthrough occurs. This will ensure that the carbon is replaced before obnoxious odors and elevated amounts of VOCs are emitted from the adsorber. The remainder of this alternative would be the same as A-2.

Capital, operation and maintenance, and present worth costs are summarized in Table 45.

Similar to A-2 this alternative uses standard engineering applications to meet the stated objectives. The use of an activated carbon treatment system is a well proven technique which will effectively capture the H_2S, mercaptans and low levels of volatile organics contained in the air emissions. As a result the treatment technology effectively eliminates the potential adverse impacts from air emissions.

Alternative A-3 achieves the remedial objectives established for the East Hide Pile. Active collection and treatment system will effectively eliminate any additional impact to the public welfare, as discussed in connection with Alternative A-2. releases. Stabilizing and covering the pile with an impermeable membrane will eliminate the potential for direct public contact with the wastes, will protect the surface waters from the effects of sloughing and sedimentation, thus protecting the surface water quality from being degraded.

This alternative does not meet or exceed all the applicable or relevant and appropriate regulations because of the filling of the wetlands. It will meet or exceed the applicable or relevant and appropriate Federal and State requirements for the eliminate of gaseous emissions, specifically odor.

The treatment system will not reduce, recycle or degrade the actual source creating the odor. As a result, the remedial action will require O&M and monitoring until natural degradation of the wastes is completed. Once the remedial action under this alternative begins, the length of time for the pile to come into equilibrium cannot be predicted.

A-4 Dewatering, slope stabilization, gas collection and treatment utilizing thermal oxidation followed by installation of 20 mil PVC synthetic membrane, cap with topsoil and vegetation.

This alternative is similar to A-3 except for the treatment method used to eliminate odors. Because methane gas, a combustible gas, is a principal component of the pile's emissions, thermal oxidation is a feasible alternative. The RI measured emission rates from various locations within the pile over time. These rates varied depending on weather conditions, time of year and amount of recent precipitation. Based on data collected, the FS screened various treatment scenarios based on the emission rates of gases from the East Hide Pile. The FS concluded that either the treatment system proposed in alternative A-3 or the one proposed in this alternative would be equally effective in meeting the established remedial objectives. The primary difference in selection of either alternative A-3 or alternative A-4 is one of cost-effectiveness. The FS concluded that alternative A-3 was more cost effective in removing the odors than alternative A-4 if the rate of gaseous emissions remained relatively low. If however, the emission rate exceeded 2 actual cubic feet per minute (ACFM) then alternative A-4 was more cost effective than than alternative A-3. The treatment system proposed under this alternative consists of a small pre-manufactured incinerator unit using liquid propane as a supplemental fuel to maintain an exit temperature between 1,400-1,600 °F. At these temperatures the H_2S would be thermally oxidized.

Since A-4 differs from A-3 only in its substitution of incineration for carbon adsorption as the gas treatment system and since the two treatment systems are equally effective, A-4 also meets the remedial objectives for the Site.

The alternative uses well proven technologies to implement the remedial action. The use of a small commercially available incinerator makes the implementation of this alternative simple and straight forward. As such, the alternative presents no significant engineering or implementation problems and would provide a high degree of reliability. All other construction details are the same as evaluated in A-3.

The use of this alternative would pose the same impacts and concerns as the previous Alternative, A-3, including destroying the wetland. Thus A-4 meets the applicable or relevant and appropriate Federal public health and environmental requirements for air but not for wetlands. Since the alternative uses incineration, the H_2S would be converted into SO_2. The FS estimated that SO_2 emissions would be well below the established

Massachusetts Primary and Secondary Ambient Air Standards, developed in conformance with the Federal Clean Air Act (CAA). If thermal oxidation is chosen to remove H_2S, mercaptans, and VOCs from the East Hide Pile, a sampling and analysis plan should be developed in the design phase for SO_2, particulates, toxics, and VOCs to ensure the safety of the public and to ensure that the National Ambient Air Quality Standards (NAAQS) are not exceeded.

This alternative does not recycle, reuse, minimize or destroy the wastes.

<u>A-5</u> <u>Complete excavation and removal of the East Hide Pile, contain material in an on-site RCRA landfill, gas treatment.</u>

Alternative A-5 involves the excavation of the entire East Hide Pile and relocation to an on-Site RCRA landfill. This alternative was initially discussed as part of the S-7 alternative for remediating soils contaminants. The capital, operation and maintenance and present worth costs associated with this alternative are found in Table 47.

While the East Hide Pile could be excavated and transported simply and directly to the new facility, the operation is infeasible because of the intense short term adverse impacts caused by the action itself. As stated previously, any disturbance of these deposits releases a strong pungent and obnoxious odor, creating a situation which would not be tolerated by either the construction workers, area businesses or the neighboring community. Also noted eariler, in spite of numerous experiments, no way of excavating these materials without generating odors was ever found. As a result, the need to physically remove the piles in order to protect the public health, welfare and environment is unwarranted given these adverse impacts and attendant violations of DEQE air regulations.

In addition to the adverse air impacts, implementing this alternative would significantly impact the abutting surface waters and wetlands. In the previous alternatives, the need to drain and fill the pond in order to depress the local groundwater table was an integral part of the proposed remedial action. Under this alternative, once the pile was removed there would not be a need for groundwater table adjustment and as a result, at least in theory, the pond and associated wetlands would not be impacted. As a practical matter there would a substantial adverse impact to the local surface waters and wetlands resulting from this alternative. As stated throughout this document, the East Hide Pile is physcially located in and next to the pond and wetlands. The physical size and location of the pile would require a substantial earthmoving effort in order to accomplish the relocation to the on-Site RCRA facility. Access and egress roads would need to be constructed in order to be able to effectively remove the deposits. A major portion of these roads would be located in the wetlands, around the pile and in parts of the pond, effectively destroying the wetlands and pond. In addition, sedimentation and erosion control would be a major concern for those portions of the wetlands and pond remaining.

This alternative does not effectively involve the reuse, recycling, minimization or destruction of the wastes, rather it seeks to eliminate the present and future potential threats to the public health and environment through the use of containment techniques.

A-6 <u>Complete excavation and off-site removal of East Hide Pile to a RCRA approved facility.</u>

Alternative A-6 was evaluated as part of the screening process. The alternative did not receive a detailed analysis because the FS screened it out. However, it is included and briefly discussed here as a benchmark for the upper range of remedial actions. Alternative A-6 involved the excavation and off-site disposal of the East Hide Pile. The waste would be transported to an approved RCRA landfill for disposal. The capital costs associated with this alternative are $35.86 million.

The public health and environmental impacts of this alternative are similar to those previously outlined in alternative A-5.

F. <u>Development and Screening of Groundwater Alternatives</u>

Two plumes of contaminated groundwater were detected in the southeastern portion of the Site during the Phase II remedial investigation. The plumes, of unknown origin, containing volatile organic compounds (benzene and toluene) have migrated off-site and if left untreated would ultimately impact the Wells G&H aquifer that yielded water to the former municipal water supply wells. The FS evaluated a number of alternatives to minimize or eliminate the present and future potential impacts to the public health, welfare and environment resulting from these plumes. Listed below are the alternatives initially screened pursuant to § 300.68(g) of the NCP.

<u>GROUNDWATER ALTERNATIVES</u>

- No Action

<u>Groundwater Interception/Recovery</u>

- Slurry wall around Site perimeter tied into possible underlying confining strata.

- Slurry wall at north end of Site tied into possible underlying confining strata.

- Slurry wall across southern boundary of Site tied into possible underlying confining strata.

- Slurry wall across southern boundary of Site and along East and West Site boundaries, south of hide piles to mid Site and tied into possible underlying confining strata.

- Slurry wall around detected groundwater plume near wells OW-12 and SD-55.

- Slurry wall across northern boundary and southern boundary of the Site tied into possible underlying confining strata.

- Grout curtain around entire Site anchored in bedrock.

- Grout curtain across northern boundary of Site anchored in bedrock.

- Grout curtain across southern boundary of Site anchored in bedrock.

- Grout curtain across southern and northern boundaries anchored in bedrock.

- Grout curtain around detected groundwater plume near wells OW-12 and SD-55.

- Bottom seal under entire Site by injection of a grout curtain base layer.

- Pump groundwater via recovery well system along entire perimeter of the Site.

- Pump groundwater via recovery well system along northern boundary of the Site.

- Pump groundwater via recovery well system along southern boundary of the Site.

- Pump groundwater via recovery well system in the vicinity of the detected groundwater plume near wells OW-12, SD-55, and OW-6.

- Pump groundwater via recovery well system along the northern and southern boundaries of the Site.

- Construct interception trench along northern boundary of Site between East/West Hide Piles and wetlands.

- Construct interception trench along northern and southern boundary of Site.

- Construct interception trench along southern boundary of Site.

- Construct interception trenches downgradient of detected contaminant plumes near wells OW-12 and-55.

Groundwater Treatment

- Treat recovered groundwater with air stripping column for VOC removal.
- Treat recovered groundwater with granular activated carbon (GAC) columns for removal of adsorbable organic compounds.
- Treat recovered groundwater with powdered activated carbon (PAC) for removal of adsorbable organic compounds.
- Treat recovered groundwater with oxidizing agent for odor destruction.
- Treat recovered groundwater with ion exchange resins for cation and anion removal.
- Treat recovered groundwater with suspended or attached growth biological reactors for removal of biochemical oxygen demand (BOD)
- Treat recovered groundwater with air stripping column and with PAC.
- Treat recovered groundwater with reverse osmosis for multi-compound removal.
- Treat recovered groundwater with pH adjustment/precipitation-flocculation/sedimentation for metals removal.
- Install permeable treatment beds (GAC) downgradient of East and West Hide Piles.
- Install permeable treatment beds (GAC) downgradient of wells OW-12 and SD-55.
- Install permeable treatment beds (GAC) along downgradient boundary of Site.

Groundwater Discharge

- Direct discharge to MDC sewer.
- Treatment, discharge to MDC sewer.
- Direct discharge to downgradient surface water body.
- Treatment, discharge to downgradient surface water body.
- Treatment, recharge to the Site substratum.

Alternatives capable of eliminating or minimizing the impact to the aquifer resulting from the organics plume were subjected to an initial screening broke into three sections; groundwater interception/recovery, groundwater treatment and discharge of groundwater to the environment.

The use of containment barriers, slurry walls or grout curtains both with and without groundwater pumping were evaluated for application at the Site. Various combinations of these techniques were evaluated. The intent of containment technique is to control and contain either the contaminant itself or the upgradient groundwater so that the contaminant can be pumped from the aquifer in the most efficient manner without inducing a large amount of uncontaminated groundwater into the collection system. The effectiveness of this technique is largely dependent on the ability to seal the containing structure against an impermeable layer, such as bedrock or till. Geologic conditions at the Site make implementation of this technology difficult. The bedrock to the east, west, and south of the Site is pervasively fractured, permeable and dips steeply. As a result, it would not be suitable as an impermeable layer into which to tie a barrier. In addition, the Agency has found that slurry walls tend to leak, allowing contaminants to be continued to be released to the environment. Slurry walls, therefore, will not meet the groundwater clean-up objective. For these reasons containment barriers were excluded from additional consideration.

Water table adjustment to minimize groundwater flow through the waste deposits was subject to the initial screening process. This alternative uses either interceptor wells to extract groundwater or subsurface drains to depress the level of groundwater below the waste deposit. Diverting the groundwater below the deposit greatly reduces the leaching potential. The technique remains effective so long as there is continued extraction of groundwater at a sufficient rate to keep the groundwater table depressed. This technique is usually used in conjunction with impermeable cover to eliminate the effects of precipitation.

The water table adjustment technique is most efficient when the source of the groundwater plume is fairly large, in contact with the groundwater and will continue to leach into the groundwater if allowed to remain. Maximum effectiveness then occurs when low pumping rates produce a significant lowering of the water table. Neither case is found on-site. The RI investigation failed to locate a source of the organics impacting the groundwater. In order to make this technique effective, an impermeable cover would need to be placed over the entire Site in order to reduce the amount of precipitation leaching organics into the groundwater. Site conditions and the nature and extent of the plumes cause this technique to be excluded from further consideration based on acceptable engineering practices.

The next component of the screening process was the evaluation of possible treatment alternatives. The FS screened twelve groundwater treatment processes for possible use at the Site. These twelve processes were evaluated as unit operations capable of being combined in some manner to form a treatment system which would effectively treat the contaminated groundwater. As a result, the initial screening focused more on the use of specific technologies to treat contaminants than discrete and complete treatment systems. The detailed analysis of groundwater alternatives does address complete treatment systems and not unit processes. Of the twelve unit processes initially screened, four were eliminated from further consideration. The reasons why they were excluded are summarized below.

Treatment of the recovered groundwater with ion exchange resins was evaluated and excluded based on cost and acceptable engineering practices. The use of ion exchange resins is particularly effective for the metals and considerably less effective for volatile organic compounds such as those found in the groundwater on-site. Because the primary contaminants of concern are volatile organics and not metals, the application of ion exchange is not effective.

Treatment of the groundwater using reverse osmosis was also evaluated. Osmosis is the flow of a solvent (e.g., water) from a dilute solution through a semipermeable membrane (dissolved contaminants permeate at a much slower rate) to a more concentrated solution. Reverse osmosis is the application of sufficient pressure to the concentrated solution to overcome the osmotic pressure and force the net flow of water through the membrane toward the dilute phase. This allows the concentration of solute (contaminants) to build up on the one side of the membrane while relatively pure water is transported through the membrane. Ions and small molecules in solution can be separated from water by this technique.

The basic components of a reverse osmosis unit are the membrane, a membrane support structure, a containing vessel, and a high pressure pump. The membrane and membrane support structure are the most critical elements.

The use of reverse osmosis is usually limited to polishing low flow waste streams containing high concentrations of contaminants. Because reverse osmosis is extremely sensitive to fouling, plugging and chemical attack, it requires extensive pretreatment and careful operation to ensure effective removal. Because of these concerns and associated costs, the FS excluded reverse osmosis from further consideration based on acceptable engineering practices and cost.

The use of powdered activated carbon (PAC) was evaluated as was granular activated carbon (GAC). GAC was retained for further evaluation, but PAC was eliminated because it did not offer an increase in environmental effectiveness but did have higher operation and maintenance (O&M) costs associated with it.

At sites where the contaminated groundwater is relatively shallow, the use of permeable treatment beds may be an effective method to intercept and treat the groundwater. The beds are built by excavating a trench downgradient of and perpendicular to the flow of contaminated groundwater and backfilling it with a media which is capable of either chemically or physically removing the contaminant. The use of this technology was rejected for use at the Site based on acceptable engineering practices and effectiveness. The permeable treatment beds are subject to plugging, saturation of the media, and short circuiting. As a result the beds would not provide the long term treatment or reliability necessary to ensure effective removal of the contaminants.

The last component evaluated during the screening of groundwater alternatives was the discharge of the treated effluent. Each alternative was evaluated for acceptable engineering practices, effectiveness and costs. Differences in cost was not a significant factor for this portion of the evaluation.

The first alternative evaluated was the discharge of the treated effluent to the Metropolitan District Commission (MDC) sewer. A major MDC interceptor sewer line is located on-site paralleling the train tracks. The FS evaluated the feasibility of this alternative but rejected it based on effectiveness. Several factors serve as the basis for its rejection. First, the MDC regulations prohibit the discharge of groundwater into its system. More importantly is the fact the MDC operates a regional system of which only a relatively small percentage of the wastes received treatment. This small percentage receives primary treatment prior to discharge into Boston Harbor. Primary treatment is ineffective in removing the contaminants of concern. Finally the system is old, in various states of disrepair and generally overloaded. During a major storm event, many of the system's sewer lines surcharge, dumping untreated waste into the surrounding environment. Even though the anticipated discharge would be an insignificant portion of the total flow handled by the system, the alternative does little to effectively contribute to the protection of public health and welfare and the environment.

The FS evaluated the disposal of the treated effluent by recharging it to the aquifer using a trench or leachfield. This alternative is unsuitable for use in situations involving large quantities of treated effluent, except in limited applications.

The aquifer in the general Site area is relatively shallow. As a result the aquifer has a limited capacity to accept the introduction of large quantities of water over a short period of time. Any discharge from a treatment system would be limited to approximately 50-100 gallons per minute (gpm). Quantities in excess of these values would cause ponding and flooding to occur.

The anticipated discharges from the treatment plants are projected to be greater than the ability of the aquifer to assimilate the discharge; as a result, this alternative was dropped from further consideration, based on acceptable engineering practices.

Discharge to the aquifer downgradient of the Site via an injection well was rejected for same reasons.

G. Detailed Analysis for Groundwater Alternatives

The FS retained three alternatives for detailed evaluation involving remediation of the groundwater. The alternatives, labelled GW-2, GW-3 and GW-4 involve various interception, treatment and discharge options necessary to minimize or eliminate the present or future threat to the public health, welfare and environment posed by the organic plume in the groundwater. Similar to the previous evaluations, the no action alternative, GW-1, was not specifically delineated in the FS. For the purposes of the ROD the no action alternative will be considered.

Again, similar to the previous media discussed, the groundwater remedial alternatives retained for detailed analysis have been renumbered for readibility.

New Number	Old number found in RI/FS
GW-1 Shall be considered the No Action Alternative	Not specifically addressed in FS as a discrete remedial alternative.
GW-2	Option 1, On-Site, hot-spot recovery groundwater plume
GW-3	Option 2, Recovery at Site Boundary of groundwater plume
GW-4	Option 3, Recovery downgradient of Site of groundwater plume

It should be noted that FS evaluated a number of unit processes for a treatment system. FS assumes that any combination of unit processes could be applied to each alternative above.

GW-1 No Action Alternative

The no action alternative allows the existing plumes to continue to migrate off-site unabated. The only action required would involve the periodic monitoring of groundwater quality, both to track the downgradient migration of the plume and to detect any significant changes in the status of the plumes which might require additional actions to be taken. Under this alternative the plumes would continue to impact groundwater quality, not only immediately downgradient of the Site, but by ultimately reaching Wells G and H aquifer. As stated earlier, Wells G and H once served as a municipal water supply prior to detection of contamination.

According to costs developed from Appendix I and summarized in Table 52, the quarterly monitoring costs would be $90,000 per year with a present worth costs (assuming a 10% discount rate and a 30 year monitoring period) of approximately $850,000. There are no operation and maintenance costs associated with this alternative except for any monitoring system installed as part of the overall Site remediation.

Discussion of engineering implementation, reliability and constructability is inappropriate, as this is a no action alternative.

The no action alternative does not effectively prevent, mitigate, or minimize threats to, and provide adequate protection of public health and welfare and the environment. Under this alternative, contaminants would continue to be released to the off-site environment permitting an adverse impact to the downgradient groundwater quality. In addition, the alternative would not comply with applicable or relevant and appropriate Federal public health and environmental requirements. The use of the groundwater protection standards under RCRA Part 264 Subpart F, while not applicable would be relevant and appropriate. These standards require that groundwater leaving a Site must meet either background levels, alternate concentration limits (ACLs) or Maximum Contaminant Levels (MCLs) established under the Safe Drinking Water Act (SDWA). The FS concluded that under this alternative, levels of benzene found at Well G would range between 5 to 10 ppb, above the MCL of 5ppb and well above the RMCL of zero.

In addition to the requirements under RCRA, the Agency's groundwater Protection Strategy (GWPS) would require clean up to similar levels. (The reader is referred to the Consistency with Other Environmental Requirements section for more detail.)

This alternative does not reuse, recycle, minimize of destroy the contaminants, nor does it employ the use of advanced or innovative technologies.

Implementation of this alternative would not pose any adverse environmental impacts.

<u>GW-2</u> <u>Groundwater interception/recovery of on-site "hot spot" areas.</u>

This alternative involves the selective placement of groundwater recovery wells in the vicinity of the highest detected concentration of benzene. With proper well placement the FS calculated that approximately 80% of the benzene detected would be extracted from the groundwater over a three month period. In addition to the benzene a substantial portion of the toluene would also be captured. The exact number and location of the wells would be determined as part of the Remedial Design (RD) process. The prime criteria to be resolved in the RD is maximizing the contaminant capture while minimizing the length of pumping required. The captured groundwater would be treated to eliminate potential obnoxious odors. Treatment would consist of the addition of ferric chloride and hydrogen peroxide as strong oxidizing agents to quickly break down odor causing sulfur compounds. This treatment would be followed by the use of two counter flow air stripping towers. The use of this type of treatment is particularly effective (99± % removal) for the compounds identified in the groundwater. The effluent of the treatment system would be discharged upgradient of the plumes via a subsurface leachfield. The costs associated with this alternative are summarized in Table 22.

The implementation of this alternative uses conventional engineering technologies and is simple and straightforward to implement. The application of groundwater recovery wells, odor abatement and air stripping for volatile organic compounds (VOCs) are all well established and proven techniques. While subsurface discharge is a proven technology, its success is dependent of a number of factors. Typically the primary problem with subsurface discharge is the clogging at the reinjection point from a stimulated bacterial growth. In the case of Industri-plex, bacterial growth is of real concern due to the presence of a high BOD detected in the on-site groundwater. In addition the presence of a high groundwater table may cause ponding of the leaching trench at the anticipated discharge rates. On the positive side, discharge to the aquifer upgradient of the plume will increase the hydraulic gradient and thereby decrease the required pumping times. By discharging upgradient a higher degree of protection from treatment process upsets would be provided as the effluent would be recycled through the system. The overall effectiveness of this alternative would not be materially affected if the surface discharge portion of the alternative was eliminated. Discharge to surface water would be substituted.

This alternative will effectively prevent, mitigate, or minimize threats to, and provide adequate protection of the public health and welfare. It is marginally protective of the environment. Currently the aquifer underlying the Site is unused as a potable water source and only used by several industries as non-contact cooling water. As a result, at present there is no impact to the public health and welfare. While groundwater analysis indicates that the plumes have migrated off-site impacting the environment, surface water quality sampling has failed to detect any impact resulting from shallow groundwater discharging to nearby streams or Hall's Brook Storage Area. The relatively low capital costs, associated lower O&M costs and relatively short length to complete (estimated at 6 months) make this alternative attractive. The alternative, however, does not meet the applicable or relevant and appropriate Federal public health and environmental requirements for the Site. While this alternative would effectively remove approximately 80% of the contaminants from the groundwater, the remaining 20% would be allowed to migrate off-site. As previously noted in alternative GW-1, off-Site migration of contaminants would not comply with RCRA nor meet the intent of the groundwater Protection Strategy.

The alternative uses treatment of groundwater as a technique to minimize present and future adverse impacts on the groundwater underlying the Site.

Implementation of GW-2 does not pose any significant adverse environmental impacts. However there are several issues which need to resolved as part of the RD. These include, accurate definition of the "hot spot" area so that the type, number and location of recovery wells can be determined, sizing of the treatment system and further investigation as to the feasibility of the use of a subsurface discharge.

<u>GW-3</u> <u>Groundwater interception/recovery at Site boundary, treatment with surface water discharge</u>

The implementation of GW-3 is similiar to that of GW-2 except for the location of the interception system. Alternative GW-3 would intercept the groundwater at the southern boundary of the Site, thereby preventing any further off-site impact. The RI calculated that placement of five interceptor recovery wells with a total pumping rate of 110 gpm would remove approximately 95% of the benzene within a ten year operating period.

Once collected the recovered groundwater would require treatment. The sampling results from the monitoring wells located along the southern edge of the Site contained high values (300 ppm) of biochemical oxygen demand (BOD). The study concluded that the probable source of the high BOD was the organic materials leaching from the buried hide deposits. The FS determined that, in addition to odor control and VOC removal, BOD treatment would be required in order to minimize clogging of the air stripping towers and to meet NPDES requirements. The FS concluded that use of a Rotating Biological Contactor (RBC) unit would provide effective reduction in BOD while minimizing O&M costs and susceptability to shock loadings. The remainder of the treatment process is similar to that of GW-2. Discharge of the treated effluent will be to the local surface water. Costs and specifications for GW-3 can be located in Tables 23 and 24.

The implementation and reliability of GW-3 is similar to that of GW-2 and does not present any significant implementation problems. Concerns similar to those noted in GW-2, such as the design of the recovery well system will be resolved as part of the Remedial Design.

Similar to alternative GW-2 this alternative was found to meet the remedial objectives established for the Site and like GW-2 this alternative does not meet all applicable or relevant and appropriate Federal public health and environmental requirements. The FS calculated that using this alternative would reduce the concentration of benzene at Well G below the MCL of 5 ppb. However RCRA and the GWPS require that the MCL criteria be applied to the aquifer immediately downgradient of the Site as a potential receptor of concern, not an actual receptor, Wells G and H. As a result, this alternative would not meet the relevant and appropriate requirements.

The FS determined that the effluent from the treatment system is capable of meeting NPDES standards and Water Quality Criteria and therefore would not degrade the local surface water. (see Consistency with Other Environmental Requirements section).

Similar to the previous alternative, this alternative uses treatment of groundwater as an effective technology to minimize present and future adverse impacts to the public health, welfare and environment resulting from contaminated groundwater.

Implementation of GW-2 does not pose any significant adverse environmental impacts.

<u>GW-4</u> <u>Groundwater Interception/recovery at the leading edge of the plume, treatment and surface water discharge.</u>

Alternative GW-4 uses the same basic framework as the previous alternatives. The primary difference is in the placement of the interceptor/recovery well system and the degree of treatment required in order to meet discharge requirements and effectively treat the wastes. In alternative GW-4 the interceptor/recovery well system is placed at the leading edge of the plume so as to capture the contaminants in their entirety. As a result, virtually all the contaminated groundwater is captured and pumped to the surface for treatment. Based on results from the monitoring wells, the FS concluded that metals removal for zinc, in addition to odor and VOC control, was necessary to meet water quality standards prior to surface water discharge. The FS determined that the Sulfex process for zinc removal was the most suitable treatment system for reducing the concentration of zinc to meet the standard. The metal removal process will be placed after odor control and prior to BOD removal.

The remaining treatment system is the same as described in GW-3 except in size. With the increase in recovery system size (a result of more groundwater to treat) and the addition of the Sulfex process, the disposal of waste sludges generated by the treatment process becomes a concern, under the GW-4 alternative.